LETTERS TO THE EDITOR.

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A Third Specimen of the Extinct "Dromaius ater," Vieillot; found in the R. Zoological Museum, Florence.

IN January 1803, a French scientific expedition, under Baudin, visited the coast of South Australia and explored Kangaroo Island, called by them "Isle Decrès." One of the naturalists attached to the expedition was the well-known F. Péron, who wrote an interesting narrative thereof. He noticed that Decrès Island was uninhabited by man, but, although poor in water, was rich in kangaroos and emus (*Casoars* he calls the latter), which in troops came down to the shore at sunset to drink sea-water. *Three* of these emus were caught alive, and safely reached Paris; we learn from the "Archives du Muséum" that one was placed in the Jardin des Plantes, and two were sent to "La Malmaison," then the residence of the Empress Josephine. We learn later that two of these birds lived to 1822, when one was mounted entire and placed in the ornithological galleries of the "Muséum," the other was prepared as a skeleton and placed in the comparative anatomy collections. No mention is made of the ultimate fate of the third specimen.

Péron was unaware that the emu he had found on the Kangaroo Island was peculiar and specifically quite distinct from the New Holland bird; this was found out much later, and *too late*; for after Péron and his colleagues no naturalist evermore set eyes on the pigmy emu of Kangaroo Island in its wild condition! It appears that when South Australia was first colonised, a settler squatted on Kangaroo Island and systematically exterminated the small emu and the kangaroos. When the interesting fact was ascertained that Péron's emu was a very distinct species quite peculiar to Kangaroo Island and found nowhere else, *Dromaius ater* had ceased to exist; and the only known specimens preserved in *any* museum were the *two* mentioned above, in Paris.

For some years past my attention had been drawn to a small skeleton of a Ratitæ in the old didactic collection of the R. Zoological Museum under my direction; it was labelled "Casoario," but was in many ways different from a cassowary; but other work kept me from the proposed closer investigation, and it was only quite recently, during a visit of the Hon. Walter Rothschild, on his telling me that he was working out the cassowaries, that I remembered the enigmatical skeleton. A better inspection showed us that it is, without the least doubt, a specimen of the lost *Dromaius ater*. I afterwards ascertained that it had been first catalogued in this museum in 1833; that most of the bones bore written on them in a bold round hand, very characteristic of the first quarter of the nineteenth century, the words "Casoar mâle;" and lastly, that during the latter part of Cuvier's life, about 1825-30, an exchange of specimens had taken place between the Paris and the Florence Museums. I have thus very little doubt that our specimen is the missing *third* one brought alive to Paris by Péron in 1804-5.

This highly interesting ornithological relic is now on loan at the Tring Museum, and can be seen there by any ornithologist in England who may wish to examine it. I intend shortly to give a fuller notice of this valuable specimen.

HENRY H. GIGLIOLI.

R. Zoological Museum, Florence, May 15.

Chlorophyll a Sensitiser.

IT was with a feeling of great satisfaction that I read the concluding lines of Dr. H. Brown's highly interesting presidential address (NATURE, September 14, 1899). I was glad to see that this distinguished chemist, to whom the physiology of plants is so much indebted, adopts certain views on the chlorophyll function, which I have been defending for more than a quarter of a century against the leading authorities of the German Physiological School (Sachs and Pfeffer). But since some slight errors seem to have crept into Dr. Brown's statements of my opinions on the subject, I may, perhaps, be allowed to bring forward the following corrections.

Dr. Brown seems to believe that the analogy between the action of chlorophyll and that of a chromatic sensitiser was "first pointed out by Captain Abney" and "more fully elaborated" by me; and secondly, that I give "a far too simple explanation of the facts" by admitting a "*mere physical* transference of vibrations of the right period from the absorbing chlorophyll to the reacting carbon dioxide and water."

To begin with the less important question of priority, I must confess that up to this date I am not aware of Captain Abney's claims. Had I known them, I should have been the first to acknowledge my debt to that accomplished investigator, whose brilliant achievements in this line of research I have never omitted to admire. The fact that the dissociation of the carbon dioxide in the green leaf is affected by the rays of light absorbed by chlorophyll was for the first time established by my researches in 1873, and an account of these experiments presented to the International Congress of Botany in Florence (May 1874).[1] At the same date (1873) Prof. H. Vogel made his important discovery of the chromatic sensitisers, and in November 1875, E. Becquerel applied it to the chlorophyll-collodion plates. In May 1875 appeared my Russian work on the chlorophyll function, of which the French article[2] in the *Annales de Chimie et de Physique* of 1875, as expressly stated, is but an extract. In this French translation the idea that chlorophyll may be considered as a sensitiser is fully discussed. Consequently any claim of priority may be fairly advanced, only in favour of a paper having appeared in the short interval of a year—from May 1874, when I *announced the fact*, to May 1875, when I *interpreted it* in the light of H. Vogel's recent discovery. On consulting the *R. S. Catalogue of Scientific Papers*, I could not find any paper of Captain Abney's for this period 1874-1875.[3]

So far concerning the priority question. Passing to the second point, I am sorry to say Dr. Brown is decidedly in the wrong, for in my French paper just cited, and which probably escaped his notice, after discussing the quite recent discoveries of H. Vogel and Edmond Becquerel, I conclude: "Ou ne saurait pour le moment décider la question de savoir si cet effet serait dû uniquement à un phénomène physique, ou bien si la matière colorante prendrait part à la transformation chimique. Cette dernière manière de voir ferait rentrer l'action de cette matière (chlorophylle) dans la regle générale de l'action accélératrice des matières organiques dans les réactions photochimiques, car c'est généralement en absorbant les produits de la dissociation, effectué par la lumière, que les substances organiques détruisent cet equilibre qui tend à s'établir entre le corps décomposé et les produits de décomposition et c'est ainsi qu'une dissociation partielle aboutit à une décomposition complaite."[4] At a later date, in a report presented to the International Congress of Botany in St. Petersburg (1884), taking to account the subsequent photographical work on the sensitisers, I brought forward experimental proof that chlorophyll may be considered a sensitiser in Captain Abney's sense of the word: "La chlorophylle est un sensibilisateur régénéré à mesure qu'il se décompose et qui provoque en éprouvant une décomposition partielle la décomposition de l'acide carbonique."[5]

From all these quotations it may be inferred that I always kept in view the chemical aspect of the chlorophyll function, now advocated with such stress by Dr. Brown.[6]

But I did not content myself with such purely theoretical considerations, and ever since have been in search of what Dr.

[1] *Atti del Congresso Botanico tenuto in Firenze*, 1875, p. 108. At a still earlier date (*Botanische Zeitung*, 1869, No. 14), I found out the source of T. W. Draper's error, and proved that the process is chiefly due to the red rays of light.

[2] "Recherches sur la décomposition de l'acide carbonique dans le spectre solaire par les parties vertes des végétaux" (Extrait d'un ouvrage "Sur l'assimilation de la lumière par les végétaux," St. Petersbourg, 1875, publié en langue Russe) *Annales de Chimie et de Physique*, 5 serie, t. xii. 1877.

[3] Prof. Pfeffer, in his account of the whole subject ("Pflanzenphysiologie." Zweite Auflage, pp. 325-341), goes so far as to attribute this sensitiser theory of the chlorophyll function to Prof. Reinke, whose paper appeared ten years later.

[4] *L.c.* p. 40. In a footnote I add that certain physiological facts seem to agree with this point of view.

[5] "État actuel de nos connaissances sur la fonction chlorophyllienne" (*Annales des Sciences Naturelles Botanique*, 1885, p. 119).

[6] At a still earlier date (in a Russian work on the "Spectrum Analysis of Chlorophyll." St. Petersburg, 1871) I even expressed Dr. Brown's present point of view in the form of an equation:

$$XO+CO_2=XCO+O_2$$
$$+H_2O$$
$$=XO+CH_2O+O_2$$

X being Dr. Brown's hypothetical "reduced constituent of chlorophyll."

Brown so appropriately terms the "reduced constituent of chlorophyll." My persistent endeavours resulted in the discovery of *protophylline*, a substance obtainable through the action of nascent hydrogen on chlorophyll solutions.[1] Some years later I discovered this substance in the living plant.[2]

The existence of a *reduced constituent of chlorophyll* may be consequently considered as a perfectly established fact, and will be probably brought to account by the chemical theory of the chlorophyll function. I conclude my French paper with the following words:—" L'étude de ces substances ne manquera pas à jetter une vive lumière sur le *co'é chimique* de la fonction chlorophillienne *qui à été étudié dans ce dernier temps presque exclusivement au point de vue physique.*"

To sum up: though it may be clearly seen that for nearly thirty years I have been considering chlorophyll as a *chemical* sensitiser (or, strictly speaking, an *absorbent* of the products of dissociation of CO_2 and H_2O), still even now I must confess that this theory lacks direct experimental proof and may be considered only as a matter for further research, whereas the physical aspect of the question (*i.e.* that CO_2 and H_2O are decomposed through the agency of those rays of the spectrum, which are absorbed and somehow transformed by chlorophyll) is but the expression of a fact, put beyond any doubt by my researches, both on the decomposition of CO_2 and on the production of starch in the living plant.[3] But I do not abandon the hope that the discovery of the *protophylline* may turn out some day to be a step in the direction of a *chemical theory* of the chlorophyll function, somewhat similar to that of the colouring matter of the blood—an analogy which has been present to my mind ever since I became acquainted with the classical researches of Sir G. G. Stokes in that direction.

University, Moscow. CLEMENT TIMIRIAZEFF.

I REGRET that M. Timiriazeff should regard the concluding lines of my presidential address as doing him some injustice.

No one can be more impressed than I have been with the extreme beauty and importance of M. Timiriazeff's work, which cleared away many illusions, and for the first time prominently brought out the fact that the rays corresponding to the principal absorption band of the chlorophyll spectrum are those which are mainly active in the assimilatory process.

I have always regarded M. Timiriazeff's paper of 1885 (*Ann. des Sciences Nat.* [*Bot.*], vol. ii. p. 99) as being one of the most convincing and eloquent expositions in scientific literature, and the final proof of the proposition there laid down was given by the author in 1890 (*Compt. rend.* 110, 1346), when he succeeded in showing that the reappearance of starch in a depleted leaf exposed to a pure spectrum only takes place in the region of the red corresponding exactly to the principal absorption band of chlorophyll.

With regard to the first point raised in M. Timiriazeff's letter, I may say that when preparing my address I experienced a difficulty in ascertaining who it was that first drew attention to the existing analogy between chlorophyll and a chromatic sensitiser.

There is no complete list of Sir William Abney's papers, and knowing that he has sent many communications on this and cognate subjects to photographic journals in various parts of the world, I applied to Sir William Abney before writing what I did. There can be no doubt that chromatic sensitisers were very much "in the air" immediately after Vogel's discoveries of 1873, and it is probable that the application of these new ideas to chlorophyll occurred independently to Abney, Timiriazeff and Becquerel.

M. Timiriazeff's second objection is that I have not sufficiently taken into account his views of the function of chlorophyll as a *chemical sensitiser.* On this point I may say that I had in view his paper of 1885: "État actuel de nos connaissances sur la fonction chlorophyllienne," which it was fair to imagine fully embodied the author's view up to that date. It is certainly the *physical rôle* of chlorophyll which is there insisted upon, as the following quotation indicates: "Le rôle de la chlorophylle dans le phénomène de la décomposition de l'acide carbonique peut donc être résumé ainsi: elle absorbe les radiations qui possèdent la plus grande énergie et transmet cette énergie aux molécules de l'acide carbonique qui, à elles seules, n'éprouveraient pas de décomposition, étant transparentes pour ces radiations énergiques."

That the physical conception was certainly uppermost in M. Timiriazeff's mind at that time is further shown by the diagram and remarks immediately following, in which he regards the molecules of carbon dioxide as suffering "shipwreck" in the luminous undulations corresponding to maximum amplitude.

It is, however, quite clear from M. Timiriazeff's references to his paper of 1877, and especially to his Russian paper of 1871, neither of which I have seen, that he has expressed views which are practically identical with those contained in the concluding remarks of my address. It is to be regretted that these ideas were not again clearly brought forward in the 1885 paper, which purported to give the author's latest views on the whole question, and that the physical idea of the immediate transference of the energy of radiation was there made the dominant one.

52, Nevern Square, Kensington. HORACE T. BROWN.

A Simple Experiment on Thermal Radiation.

THE following experiment, which has been successfully performed by our students for several years, may be of interest to teachers of physics.

Three chemical thermometers are chosen of equal size and shape. The bulb of one is silvered, of the other covered with dead black paint by dipping it into a mixture of lamp-black and alcohol, whilst the third is left unchanged. For silvering, any of the well-known solutions and processes will be applicable. The thermometers indicate the same temperature if there is no source of radiation near them.

But if a gas flame, for example, an Argand burner, be placed at a distance of 20 centimetres from them, so that the thermometers, hanging from a stand, are at equal distances from the flame, the temperature rises at a different rate, and to a different, though in each thermometer constant, height. The silvered

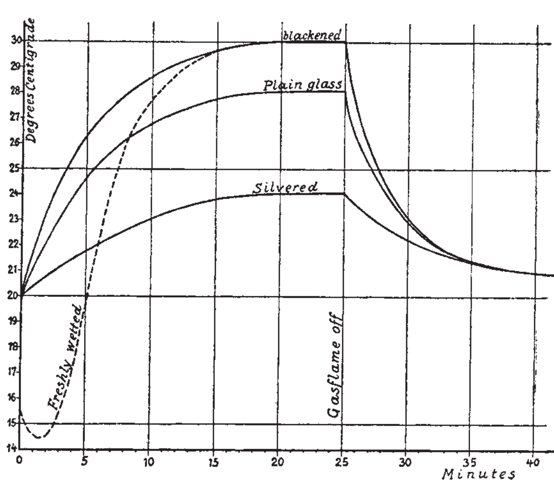

FIG. 1.

thermometer gives the lowest reading, and the blackened the highest, whilst the thread of the uncovered one stops at some point between these readings nearer to that of the blackened than the silvered; for the different surfaces of the thermometers absorb the radiation of heat generated in the flame in different proportion. The blackened thermometer bulb almost completely absorbs the rays falling on it; the silvered and polished bulb reflects the radiation reaching it; the plain glass bulb partly reflects and partly absorbs the rays. Thus, none but the silvered bulb thermometer indicates the temperature of the air communicating heat to it by conduction. As the other thermometers rise in temperature, they emit radiation; and when the amount of heat emitted from them equals the amount received through radiation from the gas flame, they are in the final stationary state, which is, of course, reached by the thermometers at different temperatures.

If the gas flame is put out, the temperatures of the three

[1] The first description of this curious substance was given in two short notes communicated to these columns: "Colourless Chlorophyll" (NATURE, 1885, p. 342) and "Chlorophyll" (NATURE, 1886, p. 52). For more ample details, see *Comptes rendus*, 1889.

[2] "La protophylline dans la plante vivante" (*Comptes rendus*, 1889).

[3] "Enregistrement photographique de la fonction chlorophyllienne par la plante vivante" (*Comptes rendus*, 1884).